Hydrogen Criteria

The Hydrogen Eligibility Criteria of the Climate Bonds Standard & Certification Scheme

Published for certification

NOTE: *These Criteria can be used to certify Use-of-Proceeds Instruments, Sustainability-Linked Debt Instruments, Assets and Entities per the Climate Bonds Standard v4.0*

Revision	Date	Summary of Changes
Rev. 2.0	November 2023	Issued for Certification
Rev. 1.1	August 2023	Issued for Public Consultation Hydrogen production and delivery criteria
Rev. 1.0	November 2022	Issued for Certification Hydrogen production criteria

Acknowledgements

Climate Bonds gratefully acknowledges the Technical (TWG) and Industry Working Group (IWG) members who supported the development of these Criteria. Members are listed in

Appendix A.

Special thanks are given to ***Emre Gençer***, the lead specialist and ***Marian Rodriguez*** for coordinating the development of the Criteria through the Technical Working Group.

The Industry Working Group provided a usability focused consultation and feedback on the criteria, but it does not automatically reflect endorsement of the criteria by all members.

Definitions

Additionality principle: Ensuring that electrolytic hydrogen is produced from additional renewable electricity.

Applicant: The term or name for any potential bond issuer, or non-financial corporate entity that might seek certification under the Steel Criteria.

Carbon Capture and Storage (CCS): describes a suite of technologies that capture waste CO2, usually from large point sources, transport it to a storage site, and deposit it where it will not enter the atmosphere. Stored CO2 is injected into an underground geological formation; this could be a depleted oil and gas reservoir or other suitable geological formation.

Carbon Capture, Utilisation and storage (CCUS): describes a suite of technologies that capture waste CO2, usually from large point sources, to then use it in other processes, or to make products.

Certified Entity: The entity or part thereof which is being certified under the Climate Bonds Standard. Currently, Entity Certification is limited to non-financial Entities or segregated segments thereof, for which the Climate Bonds Initiative has Climate Bonds Standard Sector Criteria for Entity Certification.

Climate Bonds Initiative (Climate Bonds): An investor focused not-for-profit organisation, promoting large-scale investments that will deliver a global low carbon and climate resilient economy. Climate Bonds seeks to develop mechanisms to better align the interests of investors, industry and government to catalyse investments at a speed and scale sufficient to avoid dangerous climate change.

Climate Bonds Standard (CBS): A screening tool for investors and governments that allows them to identify green bonds the proceeds of which are being used to deliver climate change solutions. This may be through climate mitigation impact and/or climate adaptation or resilience. The CBS is made up of two parts: the parent standard (CBS v4.0) and a suite of sector specific eligibility Criteria. The parent standard covers the certification process and pre- and post-issuance requirements for all certified bonds, regardless of the nature of the capital projects. The Sector Criteria detail specific requirements for assets identified as falling under that specific sector. The latest version of the CBS is published on the Climate Bonds website.

Climate Bonds Standard Board (CBSB): A board of independent members that collectively represents $34 trillion of assets under management. The CBSB is responsible for approving (i) Revisions to the CBS, including the adoption of additional sector Criteria, (ii) Approved verifiers, and (iii) Applications for Certification of a bond under the CBS. The CBSB is constituted, appointed, and supported in line with the governance arrangements and processes as published on the Climate Bonds website.

Climate Bond Certification: allows the issuer to use the Climate Bond Certification Mark in relation to that bond. Climate Bond Certification is provided once the independent CBSB is satisfied the bond conforms with the CBS.

Critical interdependencies: The asset or activity's boundaries and interdependencies with surrounding infrastructure systems. Interdependencies are specific to local context but are often connected to wider systems through complex relationships that depend on factors 'outside the asset fence' that could cause cascading failures or contribute to collateral system benefits.

Geographic correlation: Renewable electricity generation must be geographically correlated to the hydrogen production site, which means to be located in the same electricity market price area.

Green Bond: A green bond is a bond of which the proceeds are allocated to environmental projects or expenditures. The term generally refers to bonds that have been marketed as green. In theory, green bonds proceeds could be used for a wide variety of environmental projects or expenditures, but in practice they have mostly been earmarked for climate change projects.

Hydrogen production assets and projects: Assets and projects relating to the acquisition, installation, management and/or operation of equipment and infrastructure for hydrogen production.

Hydrogen delivery projects: All the operations and activities after hydrogen production and before end-use. It includes conditioning, transportation, conversion, reconversion, and storage.

Industry Working Group (IWG): A group of key organisations that are potential Applicant, verifiers and investors convened by Climate Bonds. The IWG provides feedback on the draft sector Criteria developed by the TWG before they are released for public consultation.

Investment Period: The interval between the bond's issuance and its maturity date. Otherwise known as the bond tenor.

Parent Company/Group: A company is considered a parent company of another entity (a subsidiary) if it exercises control over the subsidiary. The terms "control" and "subsidiary" have the meaning assigned to them under International Financial Reporting Standard 10 (IFRS 10). A Parent Group consists of the Parent Company and all the companies that the Parent Company exercises control over. Where the Applicant does not belong to a group of companies, the term Parent Company applies to the Applicant.

Sustainability-Linked Debt (SLD): Any debt instrument for which the financial and structural characteristics can vary depending on whether the issuer achieves predefined Sustainability/ ESG objectives. Such objectives are measured through predefined KPIs and assessed against predefined performance targets. Proceeds of SLD are intended to be used for general purposes.

Technical Working Group (TWG): A group of key experts from academia, international agencies, industry and NGOs convened by Climate Bonds. The TWG develops the Sector Criteria - detailed technical criteria for the eligibility of projects and assets as well as guidance on the tracking of eligibility status during the term of the bond. Their draft recommendations are refined through engagement with finance industry experts in convened Industry Working Groups (see below) and through public consultation. Final approval of Sector Criteria is given by the CBSB.

Temporal correlation: Ensuring that renewable energy generation and hydrogen production coincide temporally.

Transition Plans: The delivery strategy and governance implemented / to be implemented to achieve the decarbonisation targets represented by the Climate Mitigation Performance Targets of the Applicant.

Use of Proceeds Debt Instruments (UoP Instruments): The proceeds of UoP instruments are allocated to specific projects or purposes. For this Standard, UoP Instruments are for environmentally beneficial projects, assets, activities, or expenditures.

List of acronyms

A&R	Adaptation and Resilience
CCS	Carbon Capture and Storage
CCU	Carbon Capture and Utilisation
CO2eq	CO2 equivalents
EGS	Environmental, Social, and Governance
GHG	Greenhouse Gas
GWP	Global Warming Potential
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
IRENA	International Renewable Energy Agency
IWG	Industrial Working Group
NGO	Non-governmental organisations
SBTi	Science-Based Targets initiative
TWG	Technical Working Group

Table of Contents

Definitions 3

List of acronyms 4

1 Introduction 7

1.1 The Climate Bonds Standard 7

1.2 Environmental scope 7

1.3 What can be certified 7

2 The Scope of these Criteria 8

2.1 Hydrogen supply chain in scope 8

2.2 Alignment with other sector criteria 9

3 Hydrogen Production Criteria 10

3.1 Criteria for Decarbonisation Measures within Facilities Producing Hydrogen 10

3.1.1 Mitigation criteria for hydrogen production equipment, decarbonisation measures and projects within facilities producing hydrogen 10

3.1.2 Adaptation and resilience criteria for hydrogen production equipment, decarbonisation measures and projects within facilities producing hydrogen 15

3.2 Criteria for facilities producing hydrogen 17

3.2.1 Mitigation criteria for facilities producing hydrogen 17

3.2.2 Adaptation and Resilience criteria for facilities producing hydrogen 22

4 Hydrogen delivery criteria 29

4.1 Mitigation criteria for hydrogen delivery projects 29

4.1.1 Hydrogen conditioning 29

4.1.2 Hydrogen transportation 29

4.1.3 Hydrogen storage 30

4.2 Adaptation and Resilience Criteria for hydrogen delivery projects 32

5 Criteria for entities and Sustainability Linked Debt (SLD) 35

5.1 Sector specific criteria for eligible non-financial corporates 35

5.2 Criteria for Sustainability Linked Debt (SLDs) 36

List of Figures

Figure 1. Simplified Representation of the activities in scope per module and the GHG accounting system boundaries 8

List of Tables

Table 1: Assets or projects partially covered by other Climate Bonds sector criteria. 9
Table 2: Mitigation criteria 11
Table 3 Adaptation and resilience checklist for decarbonisation measures in facilities producing hydrogen 15
Table 4. Hydrogen carbon intensity thresholds towards net zero by 2050 17
Table 5. Criteria for certifying an entire facility depending on the production process. 19
Table 6: Adaptation and resilience criteria for hydrogen production facilities 22
Table 7: Mitigation criteria for conditioning 29
Table 8: Mitigation criteria for transportation 29
Table 9: Mitigation criteria for storage 30
Table 10: Adaptation and resilience checklist for hydrogen delivery projects 33
Table 11: Entities Tiered Certifications 35
Table 12: Entities Tiered Certifications 36
Table 13: SLD Tiered Certifications 36

List of Boxes, Notes and Examples

Box 1: Methodological notes for GHG accounting 18
Box 2: Methodological notes for meeting the emissions intensity threshold 20
Box 3: Notes for demonstrating additionality, temporal and geographic correlation. 21

List of Appendices

Appendix A: TWG and IWG members 37

1 Introduction

1.1 The Climate Bonds Standard

Investor demand for climate bonds is strong and is expected to increase in line with the delivery of quality products into the market. However, investor concerns about the credibility of green labelling are also growing. Standards, assurance & Certification will be essential to improve confidence and transparency, which in turn will enable further strong growth in the market.

Today, the Climate Bonds Standard and Certification Scheme is an easy-to-use screening tool that provides a clear signal to investors and intermediaries on the climate integrity of Certified Climate Bonds. Proposals are currently under consultation to also expand certification to entities with climate integrity.

A key part of the Standard is a suite of sector-specific eligibility Criteria. Each sector-specific Criteria sets climate change benchmarks for that sector that are used to screen assets and capital projects, and increasingly entities, so that only those that have climate integrity, either through their contribution to climate mitigation, and/or to adaptation and resilience to climate change, will be certified.

These sector-specific Criteria are determined through a multi-stakeholder engagement process, including TWG and IWG, convened and managed by Climate Bonds, and are subject to public consultation. Finally, they are reviewed and approved by the Climate Bonds Standard Board (CBSB).

The second key part of the Climate Bonds Standard (CBS) is the overarching CBS available at Climate Bonds Standard v4.0. This documents the common management of proceeds and reporting requirements that all Certified Climate Bonds must meet, in addition to meeting the sector specific Criteria.

1.2 Environmental scope

Currently, certification requirements address:

- Climate change mitigation; and
- Climate adaptation and resilience; and
- Other environmental impacts

1.3 What can be certified

Subject to meeting the eligibility criteria in the following sectors, the following can be certified under these criteria:

- Use-of-Proceed (UoP)[1] bonds financing decarbonisation measures within facilities producing hydrogen (e.g., retrofits) - or manufacturing of equipment for hydrogen production and use ***see Section 3.1***
- Use-of-Proceed (UoP) bonds financing hydrogen production facilities (i.e., assets) - ***see Section 3.2***
- Use-of-Proceed (UoP) bonds financing hydrogen delivery projects (i.e., assets and activities relating to conversion, transportation, and storage of hydrogen) - ***see Section 4***

The following can be certified following the update of the Overarching Climate Bonds Standard v4.0:

- Assets not linked to any specific financing instrument (hydrogen production facilities) - see ***Section 3.2***
- Entities (hydrogen production companies, hydrogen equipment companies, gas network operators, hydrogen transportation companies, hydrogen storage companies) and Sustainability Linked Bonds (SLBs) issued by those entities - see ***Section 5***

[1] Use-of-Proceed (UoP) is used as shorthand throughout this document for a variety of targeted finance instruments, including green loans, repos, and asset-backed securities. Annex 1 of the Standard v3.0 details the full list of instruments that can be certified.

To demonstrate compliance with the following Criteria, in accordance with the Climate Bonds Standard, it is the applicant's responsibility to provide the information to prove compliance with each component of these Criteria. Verifiers must include this information in the scope of verification.

2 The Scope of these Criteria

Applicants of certification must comply with the criteria related to the modules of the value chain they are involved in. However, a compatible emissions intensity target is included, allowing different production and delivery pathways combinations to meet the required total emissions intensity for a project to be certified.

2.1 Hydrogen supply chain in scope

The Hydrogen Criteria apply to eligible assets, projects and entities relating to the **production, conditioning, conversion, transportation, and storage** of hydrogen. It covers activities across the hydrogen value chain, except for end-uses, which are part of each end-use sector criteria.[2] The diagram below in figure **1** is a simplified representation of the activities that can be certified per module (within the orange dotted line), and the system boundaries for the GHG accounting[3] (within the red dotted line). The activities within the purple dotted line are partially covered by other sector´s criteria.

Total GHG emissions must include emissions from feedstock acquisition, hydrogen production, conditioning, transportation, conversion, and reconversion modules.

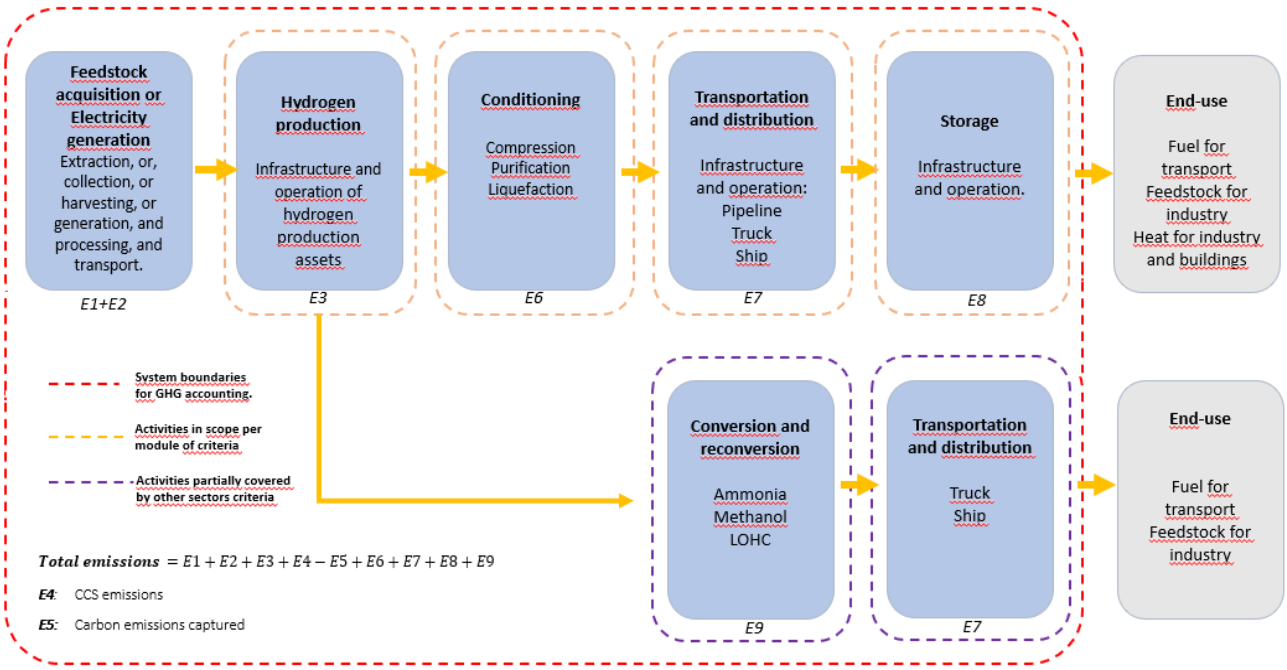

Figure 1. Simplified Representation of the activities in scope per module and the GHG accounting system boundaries[4]

[2] For example, steel production, ammonia production, power generation.

[3] The GHG accounting must be presented by the hydrogen producer.

[4] Additional details in **Box 2**

2.2 Alignment with other sector criteria

In respect of UoP bond certifications, where the proceeds will be allocated to multiple sectors, proof of compliance with multiple sector criteria may be required across the portfolio. For example, if the UoP bond is financing both hydrogen activities and steel activities, then the applicant would have to prove compliance with the Hydrogen Criteria in respect of the former and the Steel Criteria in respect of the latter.

In respect of SLB and entity certifications, where the SLB or entity Performance Targets span multiple activities within the entity, all those activities will need to be assessed against the appropriate sector criteria and an overall 'pass threshold' reached. See the Climate Bonds Standard v4.0 ***Part D Section 2.3*** for more information on this.

In some cases, it may not immediately be clear whether activities, facilities or projects might fall under these criteria or other sector criteria. The possible overlaps, and appropriate sector criteria to be used, are clarified in ***Table 1***

Table 1: Assets or projects partially covered by other Climate Bonds sector criteria.

Potential Use-of-Proceeds	Sector Criteria
Renewable energy generation including Solar, Wind, Marine Renewable, Hydropower and Geothermal energy	Relevant corresponding energy criteria.
Transporting hydrogen by truck	Low-carbon transport criteria
Transporting hydrogen by ship	Shipping criteria
Use of hydrogen for steel, cement, ammonia, and methanol production	Steel, Cement, Basic Chemicals criteria.

The following sections of this document contain the criteria per module:

- Hydrogen production, Section **3**
- Hydrogen delivery, Section **4**
    - Hydrogen conditioning, Section **4.1.1**
    - Hydrogen transportation, Section **4.1.2**
    - Hydrogen storage, Section **4.1.3**

3 Hydrogen Production Criteria

3.1 Criteria for Decarbonisation Measures within Facilities Producing Hydrogen

These criteria cover capital investments (decarbonisation measures and specific projects) within production facilities and the manufacture of equipment for low-carbon hydrogen production. It differs from an investment that would finance the cost of a whole facility in that it is focused on measures or specific areas of improvement within a production facility. Decarbonisation measures and specific projects within facilities producing hydrogen must meet:

- The mitigation criteria explained in section 3.1.1
- The adaptation and resilience criteria explained in section 3.1.2

For new projects that have not started operations when applying for certification, applicants must present a plan and quantitative report with intended emissions reduction potential, in case of CCS or CCU capture rates, and yearly climate performance plan for the bond´s duration. Once the project is certified and starts operations, the information presented is evaluated on a yearly basis over the term of the bond. If the project does not meet the criteria, the certification is revoked.

3.1.1 Mitigation criteria for hydrogen production equipment, decarbonisation measures and projects within facilities producing hydrogen

Table 2 lists decarbonisation measures, retrofitting projects, and activities eligible for certification due to their climate mitigation potential, and any associated eligibility criteria specific to those investments. These are classified in three categories:

- Various, which includes diverse activities and decarbonisation measures
    - Manufacture of electrolysers and membranes to produce hydrogen
    - Acquisition of electrolysers and membranes to produce hydrogen
    - Carbon capture and storage
    - Carbon capture and utilisation
    - Electrification of processes
- Feedstock substitution, using biogas
- Electricity source for electrolytic production, using renewable energy
- Research and development projects

Table 2: Mitigation criteria

for eligible decarbonisation measures, retrofitting activities, and projects within facilities producing hydrogen

Area	Activity	Mitigation criteria
Various		
Equipment and components to produce low-carbon hydrogen.	Manufacture of electrolysers and membranes for electrolysers.	Automatically eligible.
	Acquisition of electrolysers and membranes for electrolysers.	Automatically eligible.
Carbon Capture and Storage	Installation / acquisition of infrastructure related to CO_2 capture of emissions from hydrogen production.	• The minimum capture rate from process and combustion emission streams of 90%.[5] • A quantitative performance report of the CCS operations, including the following information[6]: ○ Intended capture rate capacity, maximum capture rate capacity, intended annual capture of CO_2, transport of CO_2, and storage of CO_2.[7] • Demonstrated MRV (monitoring, reporting and verification), and mitigation measures for methane leaks on site and upstream.[8] • Evidence[9] that demonstrates the CO_2 will be suitably transported and stored in line with the criteria below: **Transport[10]** 1. The CO_2 transported from the installation where it is captured to the injection point does not lead to CO_2 leakages above 0.5 % of the mass of CO_2 transported. 2. Appropriate leakage detection systems are installed, and a monitoring plan is in place, with the report verified by an independent third party.

[5] A minimum capture rate must be demonstrated only for specific investments on CCS or CCU infrastructure. Entire facilities certification does not need to meet this requirement if the facility meet the total carbon intensity benchmark in section **3.2.1**

[6] CCS performance report must be verified by an external verifier.

[7] Zhang *et al*, 2021. https://pubs.acs.org/doi/pdf/10.1021/acs.estlett.2c00296

[8] Additional guidance can be found in the report Best Practice Guidance for Effective Methane Management in the Oil and Gas Sector. Monitoring, Reporting and Verification (MRV) and Mitigation. United Nations Economic Commission for Europe. 2019 https://unece.org/fileadmin/DAM/energy/images/CMM/CMM_CE/Best_Practice_Guidance_for_Effective_Methane_Management_in_the_Oil_and_Gas_Sector__Monitoring__Reporting_and_Verification__MRV__and_Mitigation-_FINAL__with_covers_.pdf

[9] Either directly from the issuer or through contracts or agreements with a third party

[10] From the technical screening criteria for qualifying as contributing substantially to climate change mitigation for "Transport of CO_2" in Annex 1 of the Commission Delegated Regulation (EU) 2021/2139

Area	Activity	Mitigation criteria
		Storage[11] 1. Characterisation and assessment of the potential storage complex and surrounding area, or exploration[12] is carried out to establish whether the geological formation is suitable for use as a CO_2 storage site. 2. For operation of underground geological CO_2 storage sites, including closure and post-closure obligations: a) Appropriate leakage detection systems are implemented to prevent release during operation; b) A monitoring plan of the injection facilities, the storage complex, and, where appropriate, the surrounding environment is in place, with the regular reports checked by the competent national authority. 3. For the exploration and operation of storage sites, the activity complies with ISO 27914:2017225[13] for geological storage of CO_2. Furthermore, the use of the following certification schemes is encouraged: U.S. EPA Class VI well certification, which includes reservoir characterization[14]. The DNV GL certification framework to verify compliance with the ISO 27914:2017 Carbon dioxide capture, transportation, and geological storage - Geological storage.
Carbon Capture and Utilisation	Installation / acquisition of infrastructure related to capture, transportation, and utilisation of CO2 emissions from the hydrogen production.	• The minimum capture rate from process and energy emission streams should be 90%.[15] • A quantitative performance report of the CCS operations, including the following information[16]: ○ Intended capture rate capacity, maximum capture rate capacity, intended annual capture of CO_2, transport of CO_2, and utilisation of CO_2. • Applicant must demonstrate MRV (monitoring, reporting and verification), and mitigation measures for methane leaks on site and upstream[17]. • There is evidence[18] that demonstrates the CO_2 will be suitably transported in line with the criteria below: **Transport**[19]

[11] From the technical screening criteria for qualifying as contributing substantially to climate change mitigation for "Underground permanent geological storage of CO_2" in Annex 1 of the Commission Delegated Regulation (EU) 2021/2139

[12] 'exploration' means the assessment of potential storage complexes for the purposes of geologically storing CO2 by means of activities intruding into the subsurface such as drilling to obtain geological information about strata in the potential storage complex and, as appropriate, carrying out injection tests in order to characterise the storage site

[13] ISO Standard 27914:2017, Carbon dioxide capture, transportation and geological storage - Geological storage (version of [adoption date]: www.iso.org/standard/64148.html).

[14] www.epa.gov/uic/class-vi-wells-used-geologic-sequestration-co2

[15] A minimum capture rate must be demonstrated only for investments on CCS or CCU infrastructure. Entire facilities certification does not need to meet this requirement if the facility meet the carbon intensity benchmark in table 4.

[16] CCS performance report must be verified by an independent party

[17] www.dnv.com/news/dnv-gl-launches-certification-framework-and-recommended-practice-for-carbon-capture-and-storage-ccs--108096 Monitoring alternatives include satellite-based or drone-based measurement. Additional guidance can be found in the report Best Practice Guidance for Effective Methane Management in the Oil and Gas Sector. Monitoring, Reporting and Verification (MRV) and Mitigation. United Nations Economic Commission for Europe. 2019 https://unece.org/fileadmin/DAM/energy/images/CMM/CMM_CE/Best_Practice_Guidance_for_Effective_Methane_Management_in_the_Oil_and_Gas_Sector__Monitoring__Reporting_and_Verification__MRV__and_Mitigation-_FINAL__with_covers_.pdf

[18] Either directly from the issuer or through contracts or agreements with a third party

[19] From the technical screening criteria for qualifying as contributing substantially to climate change mitigation for "Transport of CO_2" in Annex 1 of the Commission Delegated Regulation (EU) 2021/2139

Area	Activity	Mitigation criteria
		• The CO_2 transported from the installation where it is captured to the injection point does not lead to CO2 leakages above 0.5 % of the mass of CO_2 transported. • Appropriate leak detection systems are applied and a monitoring plan is in place, with the report verified by an independent third party. **Utilisation** • CO_2 must be used for the manufacture of durable products (e.g. polymers, construction materials stored in buildings, or recyclable products. • CO_2 is not used for products that release the CO_2 immediately when the products are used (such as in urea, carbonated beverages, or fuels) • CO_2 is not used for enhanced oil recovery, and the production of other forms of fossil energy sources.
	Revamps, modifications, and other infrastructure necessary for implementing methane pyrolysis.	• Demonstrated MRV (monitoring, reporting and verification), and mitigation measures for methane leakages on site and upstream[20]. • Methane leakages below 0.2%.[21]
Electrification of processes and operations.	Revamps, modifications, and other infrastructure necessary for electrification of specific processes and operations.	Automatically eligible
Feedstock substitution		
Biogas (from biomass, landfill sites or manure) as a feedstock	Infrastructure to produce hydrogen using biogas. Refurbishment and retrofitting of facilities to use biogas.	• When using biomass, the raw material used is derived from existing supply chains and does not require dedicated production out of arable land. Only waste and residues are eligible. Wood and other dedicated crops are not eligible[22]. • Demonstrated MRV (monitoring, reporting and verification), and mitigation measures for methane leakages on site and upstream[23]. • Methane leakages below 0.2%.[24]
Electricity source		
Renewable (Wind, solar, hydro, geothermal) energy	Refurbishment and retrofitting of facilities to use renewable energy sources.	Automatically eligible

[20] Monitoring alternatives include satellite-based or drone-based measurement. Additional guidance can be found in the report Best_Practice_Guidance_for_Effective_Methane_Management_in_the_Oil_and_Gas_Sector_Monitoring_Reporting_and_Verification_MRV_and_Mitigation-_FINAL_with_covers_.pdf (unece.org)

[21] Oil and Gas Climate Initiative (OGCI) 's 0.2% target for methane intensity is frequently used as an industry standard. www.ogci.com/methane-emissions

[22] Climate Bonds Bioenergy Criteria. Section 3.2.2. Requirement 2: Reducing the risk of indirect land use impact www.climatebonds.net/standard/bioenergy

[23] Monitoring alternatives include satellite-based or drone-based measurement. Additional guidance can be found in the report Best_Practice_Guidance_for_Effective_Methane_Management_in_the_Oil_and_Gas_Sector_Monitoring_Reporting_and_Verification_MRV_and_Mitigation-_FINAL_with_covers_.pdf (unece.org)

[24] Oil and Gas Climate Initiative (OGCI) 's 0.2% target for methane intensity is frequently used as an industry standard. www.ogci.com/methane-emissions

Area	Activity	Mitigation criteria
R&D projects[25]		
Research and development projects for low-carbon hydrogen production	Research, applied research and experimental development of solutions, processes, technologies, business models and other products dedicated to the substantial reduction, avoidance or removal of GHG emissions from hydrogen production	• **TRL1 to TRL5:** Early-stage R&D may be considered eligible if aiming to bring the solution, product or technology to TRL6. • **TRL6** : Projects require that the technology is fine-tuned to a variety of operating conditions, the process is reliable and the performances match the expectations, interoperability with other connected technologies is demonstrated, the manufacturing approach is clearly defined and that all environmental, regulatory and socio-economic issues are addressed. The project brings the solution, process, technology, business model or other product through TRL 1-5; • **TRL6 or 7**: Where the researched, developed or innovated technology, product or other solution is at TRL 6 or 7, life- cycle GHG emissions are evaluated in simplified form by the entity carrying out the research. The entity demonstrates one of the following, where applicable: (a) a patent not older than 10 years associated with the technology, product or other solution, where information on its GHG emission reduction potential has been provided; (b) a permit obtained from a competent authority for operating the demonstration site associated with the innovative technology, product or other solution for the duration of the demonstration project, where information on its GHG emission reduction potential has been provided. • **TRL8**: Where the researched, developed or innovated technology, product or other solution is at TRL 8 or higher, life- cycle GHG emissions are calculated using Recommendation 2013/179/EU or, alternatively, using ISO 14067:2018 or ISO 14064-1:2018 and are verified by an independent third party.

[25] This is currently a draft and will be updated when the CBS4.1 is finalised (Feb 2024)

3.1.2 Adaptation and resilience criteria for hydrogen production equipment, decarbonisation measures and projects within facilities producing hydrogen

This section describes the Adaptation & Resilience (A&R) Component of the eligibility Criteria for decarbonisation measures. To demonstrate compliance, all measures must satisfy the requirements of the checklists detailed below in ***Table 3***.

The checklist is a tool to verify that the applicant has implemented sufficient processes and plans in the design, planning, and decommissioning phases of a measure to ensure that the operation and construction of the asset minimises environmental harm and the asset is appropriately adaptive and resilient to climate change and supports the adaptation and resilience of other stakeholders in the surrounding system, if applicable.

All elements of the checklist must be addressed, and appropriate evidence provided that these requirements are being met or are not applicable in respect of the specific measure(s) linked to the bond. It is expected that the applicant's evidence will encompass a range of assessment and impact reports and associated data, including but not limited to those reports required to meet national and local licensing and approval processes. This might include Development Consent Orders, planning regulations adhered to, Environmental Impact Assessments, Vulnerability Assessments, and associated Adaptation Plans. It is the applicant's responsibility to provide the relevant information to the verifier. Verifiers must include this information in the scope of verification. For each question in the scorecard:

- A 'yes' indicates sufficient proof given.
- A 'no' indicates insufficient proof.
- In case of a 'n/a,' please justify why the question is not applicable.

Table 3 Adaptation and resilience checklist for decarbonisation measures in facilities producing hydrogen

No.	Adaptation and resilience checklist for hydrogen production equipment, decarbonisation measures in facilities producing hydrogen	Proof Given	Overall Assessment
		For verifier to complete	
1.	**Section 1:** Clear boundaries and critical interdependencies between the measure and the system it operates within are identified.		
1.1	Boundaries of the measure are defined using: 1. a listing of all assets and activities associated with the use of the bond proceeds, 2. a map of their location, and 3. identification of the expected operational life of the activity, asset or project.		
1.2	Critical interdependencies between the measure(s) and the system within which it operates are identified. Identification of these interdependencies should consider the potential for adverse impacts arising from, but not limited to: 1. relationships of the measure(s) to nearby flood zones; 2. relationships of the measure(s) to surrounding water bodies and water courses; 3. reduction in biodiversity or High Conservation Value[26] habitat; 4. dust and other practices that affect air quality; 5. appropriation of land or economic assets from nearby vulnerable groups[27];		
2.	**Section 2:** Clear boundaries and critical interdependencies between the measure and the system it operates within are identified.		
2.1	Key physical climate risks and indicators of these risks are identified in line with the following guidelines:		

[26] High Conservation Value (HCV) habitat criteria in accordance with www.hcvnetwork.org

[27] According to IFC Performance Standards

No.	Adaptation and resilience checklist for hydrogen production equipment, decarbonisation measures in facilities producing hydrogen	Proof Given	Overall Assessment
		For verifier to complete	
	• Risks are identified based on (a) a range of climate hazards, and (b) information about risks in the current local context, including reference to any previously identified relevant hazard zones, e.g., flood zones. It is essential that the climate risks being assessed and addressed cover those that are of greatest relevance to industrial facilities and infrastructure such as hydrogen production plants and other infrastructure. The physical characteristics of climate change that must be considered in the risk assessment include: • Temperature rise o High temperatures can impact the operation and efficiency of certain types of equipment. • Increasing intense precipitation events o Heavy rainfall can result in flash pluvial flooding, which could significantly impact industrial assets. o Drought may alter or reduce availability of water with temperature increase. • Changes in cloud cover, wind speed or increasing temperature extremes o Poses risks to the availability of reliable energy, both electrical or thermal. • Sea-level rises o Potential for flooding of coastal infrastructure and assets at risk from storm surge events. • Increased soil erosion o Risks to the availability of raw materials. o Risk to transport routes for supply chains. Guidance for carrying out Risk Assessments: • Users should apply climate scenarios based on representative concentration pathway (RCP) 4.5 and 8.5 or similar/ equivalent to ensure consideration for worst case scenario. • Risk assessments should use both top-down methods and bottom-up methods that look at inherent system vulnerabilities in local context. • A broad range of models can be used to generate climate scenarios. • For risk assessment, the TCFD The Use of Scenario Analysis in disclosure of Climate-Related Risks and Opportunities is recommended.		
3.	**Section 3:** The measure is suitable to climate change conditions over its operational life		
3.1	The equipment must be tolerant to the range of climate hazards identified in item 2 of this checklist and not lock-in conditions that could result in maladaptation.		
3.2.	Risk reduction actions/strategies must be tolerant to a range of climate hazards and not lock-in conditions that could result in maladaptation.		
4.	**Section 4:** The measure does no harm to the climate resilience of the defined system it operates within, as indicated by the boundaries of and critical interdependencies with that system as identified in item 1 in this checklist.		
4.1	The equipment itself does not pose significant risk of harm to the system it is located within or others' natural, social, or financial assets according to the principle of best available evidence during the investment period, taking into account the boundaries and critical interdependencies as defined in item 1 in this checklist. Harm is defined as an adverse effect on any of the following items: 1. Adverse effects on local water bodies and water courses; 2. Air pollution from dust and other pollutants; 3. Relationships of the measure to nearby flood zones; 4. Reduction in biodiversity or High Conservation Value[28] habitat; 5. Appropriation of land or economic assets from nearby vulnerable groups[29].		

[28] High Conservation Value (HCV) habitat criteria in accordance with HCV Network

[29] According to IFC Performance Standards

3.2 Criteria for facilities producing hydrogen

For certification of an entire facility producing hydrogen, it must:

- Meet hydrogen production mitigation criteria (***Section 3.2.1.1***); AND
- Cross-cutting mitigation criteria (see ***Section 3.2.1.2***); AND
- Meet adaptation and resilience criteria (see ***Section 3.2.2)***;

3.2.1 Mitigation criteria for facilities producing hydrogen

3.2.1.1 Emissions intensity thresholds

- Hydrogen production facilities must meet an emissions intensity of **3.0 $kgCO_2e/kgH_2$** at the time of certification[30].
- Facilities using fossil resources need to be below the carbon intensity thresholds listed in **Table 4**.

Table 4. Hydrogen carbon intensity thresholds towards net zero by 2050[31]

Asset Type	Criteria			
	2023[32]	2030	2040	2050
Production of hydrogen	3.0 $kgCO_2e/kgH_2$	1.5 $kgCO_2e/kgH_2$	0.7 $kgCO_2e/kgH_2$	Close to net zero $kgCO_2e/kgH_2$

To demonstrate this, an LCA using a cradle-to-site system boundaries (cradle-to-gate plus transportation emissions) is required as described in **Box 1:**. Results should be audited by an independent third party.

[30] The 3,0 $kgCO_2e/kgH_2$ target was adopted from the EU taxonomy.

[31] The 2030 and 2050 emissions intensity targets are based on the Hydrogen council decarbonisation report. The benchmarks were taken considering the technologies that should not be incentivised in a near zero emissions trajectory. The background document, sections 4.2.2.1 and 4.2.2.2 contains additional details on this. The system boundary is cradle to gate plus delivery emissions

Box 1: Methodological notes for GHG accounting

Total GHG emissions accounting:

refer to ***Figure 1***

$$Etotal = E1 + E2 + E3 + E4 - E5 + E6 + E7 + E8 + E9$$

E total: Total emissions[33]

E1: Upstream feedstock related emissions (including sourcing[34], processing, transport and storage. Methane leakages must be included)

E2: Upstream energy related emissions (including sourcing, processing, transport and storage)[35]

E3: Process direct emissions

E4: Emissions related to CCS energy consumption and leakages

E5: CO_2 emissions captured

E6: Conditioning emissions (Energy required to compress and purify hydrogen)

E7: Transportation emissions to the site where hydrogen will be used (energy and electricity related emissions). If the producer is responsible for transportation, it must use primary data. If transportation is done by another party, it can use secondary data from the transporter or use estimations.[36]

E8: Storage of hydrogen

E9: Conversion and reconversion of hydrogen

- **GHG emissions up to the point of production**

  The life cycle assessment should follow the latest releases of ISO std[37](Using ISO 14067:2018, ISO 14040, ISO 14044 for life-cycle assessment. Projects located in Europe can alternatively use the methodology referred to in Article 28(5) of Directive (EU)2018/2001.

  The methodology factor in a Global Warming Potential for a period of 100 years (GWP100) for methane should be 30[38].

  For comparison purposes, emissions must be estimated to achieve a hydrogen purity of at least 99.9 %vol and an overpressure of at least 3 MPa.

- **GHG emissions from hydrogen transportation**

  Hydrogen transportation emissions to the site where hydrogen will be used must be included. It includes energy and electricity related emissions. The life cycle assessment for hydrogen transportation and storage should follow the latest releases of ISO std (ISO 14083:2023 Quantification and reporting of greenhouse gas emissions arising from transport chain operations). When hydrogen transportation includes conversion and reconversion processes, their energy related emissions must be included.

[33] Hydrogen leaks must be measured and mitigated. However, due to the lack of clear data available on GWP of hydrogen, it will not be included in the GHG accounting. The criteria will be updated to include hydrogen leaks in the GHG accounting once science on hydrogen GWP is further developed.

[34] Depending on the feedstock, it can be extraction, cultivation, or collection.

[35] For hydrogen production using desalination water plants, emissions from electricity must be included in the GHG accounting.

[36] Emissions from transport infrastructure, such as the construction of the pipelines or ships should not be included for the purpose of these criteria.

[37] ISO standards available at: www.iso.org/standard/38498.html; www.iso.org/standard/37456.html

[38] Sixth Assessment Report - IPCC

3.2.1.2 *Cross cutting criteria depending on the production process.*

In addition to the emissions intensity benchmark, depending on the production process, facilities must meet specific requirements described in Error! Reference source not found..

Table 5. Criteria for certifying an entire facility depending on the production process.

Type of facility	Mitigation criteria
Using fossil gas	• New facilities commencing operation in 2023 or after are eligible up to 2035. [39] • When using CCS or CCU, emissions related must be included in the GHG assessment and lead to meet the benchmark in **Table 4**.[40] • A quantitative performance report of the CCS operations, including the following information[41]: o Intended capture rate capacity, maximum capture rate capacity, annual capture of CO_2, annual transport of CO_2, annual storage of CO_2.[42] • Methane leakages must be measured, or estimated for new projects, and included in the GHG accounting. • Demonstrated MRV (monitoring, reporting and verification), and mitigation measures for methane leaks on site and upstream.[43] • There is evidence[44] that demonstrates the CO_2 will be suitably transported and stored in line with the criteria for transport and storage in **Table 2.**
Using electrolysis with renewable energy sources (Wind, solar, hydro, geothermal) energy-based electricity	• Demonstrated additional renewable electricity by implementing the following options: a) Renewable-based[45] captive power generation, OR b) A power purchase agreement demonstrating a commercial link of the electrolyser with new renewable power capacity; OR c) Excess of renewable-based electricity that would have been otherwise curtailed. • Temporal[46] and geographical correlation between the additional renewable electricity generation and the electrolyser electricity consumption must be demonstrated. See ***Box* 3** below for more details.
Using biogas as a feedstock	• Methane leakages are measured, or estimated for new projects, and included in the total GHG accounting. Demonstrated MRV (monitoring, reporting, and verification), and mitigation measures for methane leaks. • When using biomass, it is demonstrated that the raw material used is derived from existing supply chains and does not require dedicated production out of arable land. Only waste and residues are eligible. Wood and other dedicated crops are not eligible[47].

[39] After 2035 new facilities using fossil resources cannot be certified

[40] For entire facilities certifications, it is not necessary to demonstrate a minimum CCS capture rate, given that CCS related emissions must be included in the total GHG accounting. See Box 3.

[41] CCS performance report must be verified by an independent party.

[42] Zhang *et al*, 2021. https://pubs.acs.org/doi/pdf/10.1021/acs.estlett.2c00296

[43] Additional guidance can be found in the report Best Practice Guidance for Effective Methane Management in the Oil and Gas Sector. Monitoring, Reporting and Verification (MRV) and Mitigation. United Nations Economic Commission for Europe. 2019 https://unece.org/fileadmin/DAM/energy/images/CMM/CMM_CE/Best_Practice_Guidance_for_Effective_Methane_Management_in_the_Oil_and_Gas_Sector__Monitoring__Reporting_and_Verification__MRV__and_Mitigation-_FINAL__with_covers_.pdf

[44] Either directly from the issuer or through contracts or agreements with a third party.

[45] Energy produced from renewable sources such as wind, solar, and small hydropower generation

[46] The criteria included monthly temporal correlation as a starting point. It will be updated to hourly basis in 2030.

[47] Climate Bonds Bioenergy Criteria. Section 3.2.2. Requirement 2: Reducing the risk of indirect land use impact www.climatebonds.net/standard/bioenergy

Box 2: Methodological notes for meeting the emissions intensity threshold

Facilities producing hydrogen using fossil gas:

Applicants issuing a UoP bond

Applicants may either:

- Calculate the **average** facility-level emissions intensity threshold over the term of certification, and demonstrate that the facility meets that average threshold at the time of certification, OR
- Meet the threshold **at the time of certification and commit to 3 yearly assessments** by an approved verifier throughout the period of certification to verify that at each 3 yearly evaluation, the facility meets the new, lower emissions intensity threshold in place at that time. If on any 3 yearly verification the facility is not demonstrated to meet the emissions intensity threshold then in place, certification will be removed; OR
- Meet the threshold **at the time of certification, then at half of the bond duration, and at one year before the end of the bond certification.** If on any verification the facility is not demonstrated to meet the emissions intensity threshold then in place, certification will be removed

A linear trajectory should be assumed for time periods between the dates and thresholds provided in **Table 4.**

Where multiple production facilities are being assessed, this should be done facility by facility, i.e., not averaged across a portfolio of assets.

Example:

Option A. Compliant

A 10-year bond starting in 2030 for hydrogen production may demonstrate that the plant's emissions intensity at the point of issuance meets the average emissions intensity of the plant pathway between 2030 and 2040:

- 2030 threshold = 1.5 kg CO_2/kg hydrogen
- 2040 threshold = 0.6 kg CO_2/kg hydrogen
- (1.5 + 0.6) / 2 = 1.06 kg CO_2/kg hydrogen
- The facility's emissions intensity in 2030 is already 1 kg CO_2/kg hydrogen. **This is lower than the necessary averaged threshold (1.06 kg CO_2/kg hydrogen) and the facility meets the criterion. No further verification is required for meeting emissions intensity thresholds.**

Option B. Compliant

- A 10-year bond starting in 2035 would have to show compliance in annual reporting for the thresholds of 2035, 2038, and 2041. Verification must demonstrate every 3 years that these thresholds are met.

Option C. Compliant

- A 10-year bond starting in 2030 would have to show compliance in annual reporting for the thresholds of 2030, 2035, and 2039. Verification must demonstrate that these thresholds are met at every assessment.

To demonstrate compliance with any of the emissions intensity thresholds set in, applicant is required to carry out a GHG emissions assessment as described in **Box 1** *above*.

Applicants seeking certification of a hydrogen facility (not linked to any financial instrument)

The facility must meet the facility-level pathway threshold at the time of certification.[48]

[48] As this is a point-in-time certification, there is no need to continuously meet the pathway thereafter.

Box 3: Notes for demonstrating additionality, temporal and geographic correlation.

Facilities producing electrolytic hydrogen:

a) Additionality:

- **A power purchase agreement demonstrating a commercial link of the electrolyser with new renewable power capacity:** Issuers must show that the renewable power plant started operation simultaneously or after the electrolyser installation. The total electricity consumption cannot be higher than the electricity supplied by the new renewable power plants. A producer can use more than one PPA to cover the entire electricity requirements of its electrolysers.
- **Excess of renewable-based electricity that would have been otherwise curtailed**: Flexible hydrogen production projects focusing on times of high renewable generation and low emission factor. Issuers must demonstrate that the electrolyser uses renewable energy from an existing renewable plant only during those hours of the year when surpluses occur.

Additionality **is not** required when:

- Electrolysis is solving grid imbalances.
- If a producer has idle capacity (running at low-capacity factor)

b) Temporal correlation: Issuers must demonstrate that the electricity is produced and used simultaneously, monthly, using telemetry measurement techniques. Renewable electricity that has been locally stored can be used as well.

c) Geographic correlation: Issuers must demonstrate physical capacity to transport the electricity from the renewable generation plant to the electricity consumption site. The electricity must not pass a zone of grid congestion[49].

Temporal and geographic correlation **are not** required when there is direct connection to a renewable energy source.

[49] when a grid overload prevents electricity from reaching the consumer.

3.2.2 Adaptation and Resilience criteria for facilities producing hydrogen

3.2.2.1 The adaptation and resilience checklist

This section describes the Adaptation & Resilience (A&R) Component of the eligibility Criteria for hydrogen production facilities. To demonstrate compliance, all facilities must satisfy the requirements of the checklists detailed below in **Table 6.**

The checklists are tools to verify that the applicant has implemented sufficient processes and plans in the design, planning and decommissioning phases of a facility/facilities to ensure that the operation and construction of the facility minimises environmental harm and the facility is appropriately adaptive and resilient to climate change and supports the adaptation and resilience of other stakeholders in the surrounding system, if applicable.

All elements of the checklist must be addressed, and appropriate evidence provided that these requirements are being met or are not applicable in respect of the specific facility linked to certification. It is expected that the applicant's evidence will encompass a range of assessment and impact reports and associated data, including but not limited to those reports required to meet national and local licensing and approval processes. This might include Development Consent Orders, planning regulations adhered to, Environmental Impact Assessments, Vulnerability Assessments and associated Adaptation Plans.

It is the applicant's responsibility to provide the relevant information to the verifier. Verifiers must include this information in the scope of verification.

For each question in the scorecard:

- A 'yes' indicates sufficient proof given.
- A 'no' indicates insufficient proof.
- In case of a 'n/a,' please justify why the question is not applicable.

Table 6: Adaptation and resilience criteria for hydrogen production facilities

No.	Adaptation and resilience checklist for hydrogen production facilities	Proof Given	Overall Assessment
		For verifier to complete	
1.	**Section 1:** Clear boundaries and critical interdependencies between the production facility and the system it operates within are identified.		
1.1	Boundaries of the infrastructure are defined using: 1. a listing of all assets and activities associated with the use of the bond proceeds, 2. a map of their location, and 3. identification of the expected operational life of the activity, asset or project.		
1.2	Critical interdependencies between the infrastructure and the system within which it operates are identified. Identification of these interdependencies should consider the potential for adverse impacts arising from, but not limited to: 1. The effects of supply disruption or interruption on dependent electricity users or populations; 2. Exacerbation of wildfires; 3. Relationships of the asset/activity to surrounding water bodies and water courses; 4. Relationships of the asset/project to residential neighbourhoods surrounding the plant; 5. Damage or reduction in value of neighbouring property due to boundary structures at risk of falling during storm events; 6. Reduction in value of neighbourhood property due to pollution caused by the chemical facilities, due to extreme weather events (e.g., release of toxic chemicals due to failure in safety systems in case of extreme weather events);		

No.	Adaptation and resilience checklist for hydrogen production facilities	Proof Given	Overall Assessment
		For verifier to complete	
	7. Reduction in biodiversity or High Conservation Value habitat [50]; 8. Relationships of the asset/project to nearby flood zones; 9. Fire and other practices that affect air quality; 10. Appropriation of land or economic assets from nearby vulnerable groups[51];		
2.	**Section 2:** An assessment has been undertaken to identify the key physical climate hazards to which the production facility will be exposed and vulnerable to over its operating life		
2.1	Key physical climate risks and indicators of these risks are identified based on: a) a range of climate hazards, and b) information about risks in the current local context, including reference to any previously identified relevant hazard zones, e.g., flood zones. In order to be confident that assets and activities are robust and flexible in the face of climate change uncertainties, it is essential that the climate risks being assessed and addressed cover those that are of greatest relevance to the production of hydrogen. • Is there a good understanding of the risks facing the facility today? In five years? In ten years? • Are risks defined and detailed? • Are risk areas for hazardous materials[52] identified? • Was a hazard assessment conducted to identify toxic, flammable, volatile and reactive chemicals[53] [54]? • Is there an accident management plan in place? • Time horizon is set according to the severity of the risks. Higher risk locations: shorter time (every 5 years). Lower risk locations: Longer time (every 10 years). See Section 5.3 of the Background Paper for tools and reference guidelines to assess degree of risks. • Where accurate assessments of climate variability for specific locations are not possible, use worst-case scenarios. Optional guidance for carrying out risk assessments is offered in ***Section 5.3*** of the Background Document. The potential impacts that must be considered in the risk assessment include the ones described in the following sections (2.2-2.9)[55]:		
2.2	**Temperature rise and heat waves** 1. Potential increase in temperature may result in expansion and stress of plant, pipework and fittings. 2. There could be an increase in dust emissions from the site. 3. There could be an increase in odour from the site. 4. Increase in fugitive or diffuse emissions from the site. 5. Increase in pollution 6. Increase in water consumed for cooling purposes. 7. Increase in energy consumption due to added pumping of cooling water around site. 8. Limited cooling, which implies that throughputs could need to be reduced or processes shut down		

[50] High Conservation Value (HCV) habitat criteria in accordance with www.hcvnetwork.org

[51] According to IFC Performance Standards

[52] Hazardous materials include Explosive, flammable, combustible, corrosive, oxidising, toxic, infectious, or radioactive materials (Federal Emergency Management Agency)

[53] UCLID (International Uniform Chemical Information Database) software is a recommended source of data on intrinsic and hazard properties of chemical substances

[54] www.openaccessgovernment.org/climate-toxicology-human-health/68647

[55] Chemical Industries Association, 2021. Safeguarding chemical businesses in a changing climate. How to prepare a Climate Change Adaptation Plan

No.	Adaptation and resilience checklist for hydrogen production facilities	Proof Given	Overall Assessment
		For verifier to complete	
	9. Volatile chemicals can exceed their temperature range during transportation		
2.3	**Extreme cold weather** 1. Failure of trace heating systems a. Freezing of cooling water, resulting in blockages - particularly on long pipelines and storage in exposed areas. b. Process failures 2. Pipework ruptures, affecting: Boiler condensate, process water, cooling water, effluent systems, this in turn may lead to process interruption. 3. Failure of pH control due to caustic systems solidifying (such as effluent treatment) 4. Catalytic processes can be affected, reducing performance 5. Freezing of coolant lines, equipment, and chemical reaction vessel resulting in rising reaction temperature and pressure 6. Frozen onsite roadways may restrict access for staff and emergency vehicles. 7. Lack of water for fire suppression 8. Damage to site infrastructure from snow-loading over extended periods.		
2.4	**Daily extreme rainfall** 1. Flooding could lead to increased site surface water and flash flooding 2. The site may experience reduced access or egress due to site flooding. 3. Stored substances can react with water or be contaminated 4. Uncontrolled chemical reactions, for example due to shut down of refrigeration systems as a consequence of power outages and lack of backup facilities 5. Emergency relief systems, which work at atmospheric discharge pressure can be affected due to the static head of water. 6. Process equipment running hot materials can be affected by thermal stress		
2.5	**Season rainfall increase** 1. Overland flow or groundwater flooding. 2. Flooding and associated impacts, as previously identified.		
2.6	**Sea level rise** If located near the coast a site could experience increased: 1. Risk of flooding and associated impacts, as previously identified 2. Corrosion due to increase in saltwater spray 3. Reduction of useful life of assets due to frequent exposure to salty water		
2.7	**Drier seasons** 1. Potential increased use or reliance on mains water for dust suppression and cleaning. 2. Potential for increase in dust emissions from the site.		
2.8	**Decreased river flow** 1. Reduced dilution available in receiving watercourse for discharge of effluent, resulting in increased pollution		
2.9	**Wildfires** 1. Severe damage on buildings, process equipment and industrial infrastructure 2. Release of toxic pollutants 3. Volatile organic solvents with low flash points can exacerbate the fire risk		

No.	Adaptation and resilience checklist for hydrogen production facilities	Proof Given	Overall Assessment
		For verifier to complete	
	4. Explosions 5. Pipelines for transporting oil and gas, fuel storage facilities, external floating roof tanks for combustible liquids can spread the fire 6. Supply chain disruption		
3.	**Section 3:** The measures that have or will be taken to address those risks, mitigate them to a level such that the production plant is suitable to climate change conditions over its operational life have been identified and planned if not yet undertaken.		
3.1	**The following are examples** of risk management activities[56] that bond Applicant might consider, or that might be adopted as part of regulations (e.g., codes and standards). This list is not exhaustive and bond Applicant should fully assess the mitigation measures that are relevant to the climate risks and impacts identified in the risk assessment. Measures depend on the specific and local conditions of an asset.		
3.2	**Temperature rise and heat waves** 1. Identify temperature limits that could impact your processes and workers 2. Regular inspection and preventative maintenance of plant and equipment 3. Regular site cleaning and use of dust suppression systems 4. Appropriate odour abatement is in place and maintained effectively 5. Appropriate odour management plan is in place 6. Make sure an appropriate fugitive or diffuse emissions plan is in place. 7. Water can be cleaned and recirculated for reuse on site 8. Alternative cooling systems. 9. Assess how efficient the current cooling system is, and to propose upgrades or modifications where necessary.		
3.3	**Extreme cold weather** 1. Identify temperature limits that could impact your processes and workers 2. Regularly inspect and maintain insulation, particularly on pipework and equipment in exposed areas of the site. 3. Consider added insulation on pipework containing water review operating procedures to make sure pipework is not left full of static water when not in use identify any potential dead-legs where static water may be held up 4. Reviewing the capability of caustic systems to remain liquid at expected colder temperatures. 5. Regularly inspect and maintain roadways during winter and remove any standing water 6. Make sure grit is available to treat road surfaces 7. Review the design of structures to withstand increased loadings.		
3.4	**Daily extreme rainfall** 1. Suitable measures are in place for the management of expected surface water and flood waters a. Drainage systems are inspected and maintained b. External areas where wastes are handled or stored are provided with contained drainage c. The site drainage system and effluent treatment plant has sufficient storage or treatment capacity 2. Make sure there are suitable alternative transport routes to and from the site.		
3.5	**Season rainfall increase** 1. Make sure suitable measures are in place for the management of anticipated overland flow or groundwater flooding.		

[56] Chemical Industries Association, 2021. Safeguarding chemical businesses in a changing climate. How to prepare a Climate Change Adaptation Plan

No.	Adaptation and resilience checklist for hydrogen production facilities	Proof Given	Overall Assessment
		For verifier to complete	
	2. Prepare flood plan including: a. Risk assessment of process equipment and services at greatest risk from flooding b. Provision of emergency pumps to remove floodwater and identification of lowest risk location for discharge of floodwaters c. Protection of control and electrical systems d. Identification and protection of flat bottom tanks at risk of floating in floodwater 3. Ensure backup power, capable of functioning during extreme weather events and guarantee the stability and safety of the stored chemicals.		
3.6	**Sea level rise** 1. Prepare flood plan including: a. Risk assessment of process equipment and services at greatest risk from flooding b. Provision of emergency pumps to remove floodwater and identification of lowest risk location for discharge of floodwaters c. Protection of control and electrical systems d. Identification and protection of flat bottom tanks at risk of floating in floodwater 2. Prevent corrosion. Measures could include making sure that plant or equipment prone to corrosion are: a. Protected, such as by being painted with resistant coating b. Regularly inspected and maintained		
3.7	**Drier seasons** 1. Measures are in place to review and minimise water use and to maximise collection and use of rainfall a. Mains water capacity is adequate, taking into account reduced availability of rainwater for activities such as dust suppression and cleaning 2. Potential for increase in dust emissions from the site.		
3.8	**Decreased river flow** 1. Review the environmental risk assessment for discharge to water from on-site effluent treatment 2. Check existing environmental risk assessment to make sure low river flow used in assessment remains valid - if not, discuss with Environment Agency (local site inspector and water quality team) and carry out an updated environmental risk assessment		
3.9	**Wildfires** 1. Implement active fire prevention measures such as fire detector, gas detector, design of sprinkler systems, use of line detectors, design of deluge systems, design of gaseous extinguishing systems29 2. Implement passive fire protection measures, like permanent inertization of warehouses, support for pipe racks, fireproofing cabling, use of fire resistance cable coating, protection of tank farms 3. Storage protection measures such as distancing to avoid fires from spreading within an industrial complex 4. Wildland and vegetation management		
4.	**Section 4:** The facilities do no harm to the climate resilience of the defined system they operate within, as indicated by the boundaries of and critical interdependencies with that system as identified in item 1 in this checklist.		
4.1	The facilities themselves do not pose significant risk of harm to the system they are located within or others' natural, social, or financial assets according to the principle of best available evidence		

No.	Adaptation and resilience checklist for hydrogen production facilities	Proof Given	Overall Assessment
		For verifier to complete	
	during the investment period, taking into account the boundaries and critical interdependencies as defined in item 1 in this checklist. 1. The effects of supply disruption or interruption on dependent electricity users or populations; 2. Exacerbation of wildfires; 3. Relationships of the asset/activity to surrounding water bodies and water courses; 4. Relationships of the asset/project to residential neighbourhoods surrounding the plant; 5. Damage or reduction in value of neighbouring property due to boundary structures at risk of falling during storm events; 6. Reduction in value of neighbourhood property due to pollution caused by the chemical facilities, due to extreme weather events (e.g., release of toxic chemicals due to failure in safety systems in case of extreme weather events); 7. Reduction in biodiversity or High Conservation Value[57] habitat; 8. Relationships of the asset/project to nearby flood zones; 9. Fire and other practices that affect air quality; 10. Appropriation of land or economic assets from nearby vulnerable groups[58].		
5.	**Section 5:** There will be ongoing monitoring and evaluation of the relevance of the risks and resilience measures and related adjustments to those measures will be taken as needed.		
5.1	Indicators for risks identified under item 2 in this checklist are provided. • Risk thresholds/trigger levels, for which new adaptation actions are set[59], are monitored		
5.2	Indicators for risk mitigation measures identified under item 3 in this checklist are provided. • Determine whether planned outputs and outcomes from adaptation actions have been achieved[60].		
5.3	Applicants have a viable plan to annually monitor and evaluate: Climate risks thresholds/triggers, climate resilience performance, and appropriateness of climate resilience measure(s) and to adjust as necessary to address evolving climate risks.		

3.2.2.2 Other environmental impacts

3.2.2.2.1 Overarching requirements

An Environmental Impact Assessment (EIA) for the facility and its site consistent with local regulations and conducted by an independent third-party expert. In addition, the following specific requirements apply:

a. Pollution prevention

For hydrogen produced from fossil resources, emissions SO_2, NO_x, CO, and dust must be lower than Best Available Techniques for refining of oil and gas[61].

b. Land use

- For hydrogen produced from biomass, applicant must demonstrate that the bioenergy production meets the low iLUC (Indirect Land Use Change) risk biomass criteria and compliance indicators under the RSB optional module.[62] [63]

[57] High Conservation Value (HCV) habitat criteria in accordance with www.hcvnetwork.org

[58] According to IFC Performance Standards

[59] The adaptation process Coastal Climate Adaptation Decision Support (C-CADS), 2018.

[60] National Climate Change Adaptation Research Facility. NCCARF, 2018.

[61] DIRECTIVE 2010/75/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 24 November 2010 on industrial emissions (integrated pollution prevention and control. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014D0738&from=EN

[62] Climate Bonds Bioenergy Criteria www.climatebonds.net/files/files/standards/Bioenergy/Bioenergy%20Criteria%20Document%20Mar%202021.pdf

[63] https://rsb.org/certification/certification-schemes/rsb-iluc-low-risk-biomass-module/

c. Water

- The environmental impact assessment must include potential impacts on water.
- A water resource management plan. Specification of when freshwater aquifers will be used, and whether these aquifers are currently used for human consumption. [64]
- A water-use license issued by the regional environmental regulator as part of the environmental authorisation process.
- A local water availability assessment and demonstration that water use for hydrogen production is not impacting water availability for human consumption and agriculture. Hydrogen production assets should not be located in regions with high water stress[65] that do not have seawater desalination as an alternative.
- For hydrogen production using desalination water plants: a brine management plan, developed and approved as within the EIA process, addressing all potential environmental risks and mitigation measures associated with brine disposal.

3.2.2.3 Disclosure Component

In the interests of transparency and disclosure, Applicant of Certified Climate Bonds are required to publicly disclose the following in respect of the assets and use-of-proceeds incorporated in that deal:

- The planning standards, environmental regulations, and other regulations that the facility has been required to comply with.
- The environmental impacts assessment and the measures to address potential risks.

[64] An aquifer that contains fewer than 10,000 mg/L total dissolved solids. U.S. EPA Underground Injection Control Program (2014).

[65] When the demand for water exceeds the supply or when poor quality limits its use

4 Hydrogen delivery criteria

The hydrogen delivery criteria cover all the activities related to conditioning, conversion, transportation, distribution, and storage of hydrogen. These criteria are focused on specific projects not related to hydrogen production. However, companies or projects dedicated to hydrogen delivery activities must present the emissions intensity of the hydrogen producer, verified by an independent party, demonstrate compliance with the 3.0 $kgCO_2e/kgH_2$ benchmark in ***section 3.2.1.1,*** or presenting an origin certification scheme, or a well stablished and recognised low-carbon hydrogen certification. For certification, the hydrogen delivery project must:

a. Meet mitigation criteria for hydrogen delivery projects (see ***Section 4.1***); AND
b. Meet adaptation and resilience criteria (see ***Section 4.2)***.

4.1 Mitigation criteria for hydrogen delivery projects

4.1.1 Hydrogen conditioning

Table 7: Mitigation criteria for conditioning

Area	Activity	Mitigation criteria
Compression or liquefaction	Acquisition of equipment for hydrogen compression or liquefaction.	• Equipment must be used for low-carbon hydrogen that meets the 3.0 $kgCO_2e/kgH_2$ benchmark in ***section 3.2.1.1,*** or that has an origin certification scheme, or a well stablished and recognised low-carbon hydrogen certification.
	Operation of hydrogen compression or liquefaction.	

4.1.2 Hydrogen transportation

Table 8: Mitigation criteria for transportation[66]

Area	Activity	Mitigation criteria
Pipelines		
Transmission and distribution networks	Construction or operation of new transmission and distribution networks dedicated to hydrogen.	• Networks must be used to transport low-carbon hydrogen that meets the 3.0 $kgCO_2e/kgH_2$ benchmark in ***section 3.2.1.1,*** or that has an origin certification scheme, or a well stablished and recognised low-carbon hydrogen certification. • Hydrogen leak detection, repair mechanisms and mitigation measures must be implemented. A plan to avoid and minimise hydrogen leakages must be presented.[67] • Follow the latest releases of the ISO/TR 15916:2016. Basic considerations for the safety of hydrogen systems.
	Conversion of existing fossil gas networks to 100% hydrogen.	• Networks must be used to transport low-carbon hydrogen that meets the 3.0 $kgCO_2e/kgH_2$ benchmark in ***section 3.2.1.1,*** or that has an origin certification scheme, or a well-stablished and recognised low-carbon hydrogen certification.

[66] Methanol and ammonia production can be certified under the basic chemicals criteria.

[67] Recommendations for mitigating and preventing hydrogen emissions from infrastructure can be found in the following link www.eesi.org/files/H2EmissionsMitigation_FACTSHEET_08MAY2023.pdf

Area	Activity	Mitigation criteria
Pipelines		
		• Projects for blending hydrogen into fossil gas pipelines are not eligible. • Hydrogen leak detection, repair mechanisms, and mitigation measures must be implemented. A plan to avoid and minimise hydrogen leakages must be presented. • Follow the latest releases of the ISO/TR 15916:2016. Basic considerations for the safety of hydrogen systems.
Liquid Organic Hydrogen Carriers (LOHC)	Using LOHC to store and transport hydrogen	• LOHC must be used to store and transport low-carbon hydrogen that meets the 3.0 $kgCO_2e/kgH_2$ benchmark in ***section 3.2.1.1.***
Ammonia	Using ammonia to store and transport hydrogen[68]	• Ammonia must be used to store and transport low-carbon hydrogen that meets the 3.0 $kgCO_2e/kgH_2$ benchmark in ***section 3.2.1.1.***
Methanol	Using methanol to store and transport hydrogen[69]	• Methanol must be used to store, and transport low-carbon hydrogen that meets the 3.0 $kgCO_2e/kgH_2$ benchmark in ***section 3.2.1.1.***
Road transport	Transporting hydrogen by truck	• Transportation must be for low-carbon hydrogen that meets the 3.0 $kgCO_2e/kgH_2$ benchmark in ***section 3.2.1.1.*** • Hydrogen leak detection, repair mechanisms and mitigation measures must be implemented. A plan to avoid and minimise hydrogen leakages must be presented.[70]
Shipping transport	Transporting hydrogen by shipping	• Transportation must be for low-carbon hydrogen that meets the 3.0 $kgCO_2e/kgH_2$ benchmark in ***section 3.2.1.1.*** • Hydrogen leak detection, repair mechanisms and mitigation measures must be implemented. A plan to avoid and minimise hydrogen leakages must be presented.[71]

4.1.3 Hydrogen storage

Table 9: Mitigation criteria for storage

Area	Activity	Mitigation criteria
Storage Infrastructure		
Underground Storage	Construction of hydrogen storage facilities	• Hydrogen stored in the facility must be low carbon, that that meets the 3.0 $kgCO_2e/kgH_2$ benchmark in ***section 3.2.1.1,*** or that has an origin certification scheme, or a well-stablished and recognised low-carbon hydrogen certification. • Hydrogen leak detection, repair mechanisms and mitigation measures must be implemented. A plan to minimise hydrogen leakages must be presented.

[68] Ammonia produced as a final product and not for hydrogen transportation and storage purposes must be certified under the basic chemicals criteria.

[69] Methanol production as a final product and not for hydrogen transportation and storage purposes must be certified under the basic chemicals criteria.

[70] Recommendations for mitigating and preventing hydrogen emissions from infrastructure can be found in the following link www.eesi.org/files/H2EmissionsMitigation_FACTSHEET_08MAY2023.pdf

[71] Recommendations for mitigating and preventing hydrogen emissions from infrastructure can be found in the following link www.eesi.org/files/H2EmissionsMitigation_FACTSHEET_08MAY2023.pdf

Area	Activity	Mitigation criteria
		• Follow the latest releases of the ISO/TR 15916:2016. Basic considerations for the safety of hydrogen systems.
	Operation of hydrogen storage facilities And Conversion of existing underground fossil gas storage facilities	• Hydrogen stored in the facility must low carbon, that meets the 3.0 $kgCO_2e/kgH_2$ benchmark in ***section 3.2.1.1,*** or that has an origin certification scheme, or a well-stablished and recognised low-carbon hydrogen certification. • Hydrogen leak detection, repair mechanisms and mitigation measures must be implemented. A plan to minimise hydrogen leakages must be presented. • Cushion gas is not CO_2 or methane. • Follow the latest releases of the ISO/TR 15916:2016. Basic considerations for the safety of hydrogen systems
Hydrogen storage tanks	Acquisition and installation of compressed or liquified hydrogen storage tanks.	• Hydrogen stored in the tanks must be low carbon, that meets the 3.0 $kgCO_2e/kgH_2$ benchmark in ***section 3.2.1.1,*** or that has an origin certification scheme, or a well-stablished and recognised low-carbon hydrogen certification.

4.1.4 Hydrogen delivery R&D projects

R&D projects[72]	
Research, applied research and experimental development of solutions, processes, technologies, business models and other products dedicated to the substantial reduction, avoidance or removal of GHG emissions from hydrogen production	• **TRL1 to TRL5:** Early-stage R&D may be considered eligible if aiming to bring the solution, product or technology to TRL6. • **TRL6** : Projects require that the technology is fine-tuned to a variety of operating conditions, the process is reliable and the performances match the expectations, interoperability with other connected technologies is demonstrated, the manufacturing approach is clearly defined and that all environmental, regulatory and socio-economic issues are addressed. The project brings the solution, process, technology, business model or other product through TRL 1-5; • **TRL6 or 7**: Where the researched, developed or innovated technology, product or other solution is at TRL 6 or 7, life- cycle GHG emissions are evaluated in simplified form by the entity carrying out the research. The entity demonstrates one of the following, where applicable: (a) a patent not older than 10 years associated with the technology, product or other solution, where information on its GHG emission reduction potential has been provided; (b) a permit obtained from a competent authority for operating the demonstration site associated with the innovative technology, product or other solution for the duration of the demonstration project, where information on its GHG emission reduction potential has been provided. • **TRL8**: Where the researched, developed or innovated technology, product or other solution is at TRL 8 or higher, life- cycle GHG emissions are calculated using Recommendation 2013/179/EU or, alternatively, using ISO 14067:2018 or ISO 14064-1:2018 and are verified by an independent third party.

[72] This is currently a draft and will be updated when the CBS4.1 is finalised (Feb 2024)

4.2 Adaptation and Resilience Criteria for hydrogen delivery projects

This section describes the Adaptation & Resilience (A&R) Component of the eligibility Criteria for hydrogen delivery projects. To demonstrate compliance, all measures must satisfy the requirements of the checklists detailed in *Table 10.*

The checklist is a tool to verify that the applicant has implemented sufficient processes and plans in the design, planning and decommissioning phases of a measure to ensure that the operation and construction of the asset minimises environmental harm and the asset is appropriately adaptive and resilient to climate change and supports the adaptation and resilience of other stakeholders in the surrounding system, if applicable.

All elements of the checklist must be addressed, and appropriate evidence provided that these requirements are being met or are not applicable in respect of the specific measure(s) linked to the bond. It is expected that the applicant's evidence will encompass a range of assessment and impact reports and associated data, including but not limited to those reports required to meet national and local licensing and approval processes. This might include Development Consent Orders, planning regulations adhered to, Environmental Impact Assessments, Vulnerability Assessments, and associated Adaptation Plans.

It is the applicant's responsibility to provide the relevant information to the verifier. Verifiers must include this information in the scope of verification.

For each question in the scorecard:

- A 'yes' indicates sufficient proof given.
- A 'no' indicates insufficient proof.
- In case of a 'n/a,' please justify why the question is not applicable.

Table 10: Adaptation and resilience checklist for hydrogen delivery projects

No.	Adaptation and resilience checklist for hydrogen delivery projects, including conditioning, transportation and storage.	Proof Given	Overall Assessment
		For verifier to complete	
1.	**Section 1:** Clear boundaries and critical interdependencies between the measure and the system it operates within are identified.		
1.1	Boundaries of the measure are defined using: 1. listing of all assets and activities associated with the use of the bond proceeds, 2. a map of their location, and 3. identification of the expected operational life of the activity, asset, or project.		
1.2	Critical interdependencies between the measure(s) and the system within which it operates are identified. Identification of these interdependencies should consider the potential for adverse impacts arising from, but not limited to: 1. relationships of the measure(s) to nearby flood zones; 2. relationships of the measure(s) to surrounding water bodies and water courses; 3. reduction in biodiversity or High Conservation Value[73] habitat; 4. dust and other practices that affect air quality; 5. appropriation of land or economic assets from nearby vulnerable groups[74];		
2.	**Section 2** Clear boundaries and critical interdependencies between the measure and the system it operates within are identified.		
2.1	Key physical climate risks and indicators of these risks are identified in line with the following guidelines: • Risks are identified based on (a) a range of climate hazards, and (b) information about risks in the current local context, including reference to any previously identified relevant hazard zones, e.g., flood zones. It is essential that the climate risks being assessed and addressed cover those that are of greatest relevance to industrial facilities and infrastructure such as hydrogen production plants and other infrastructure. The physical characteristics of climate change that must be considered in the risk assessment include: • Temperature rise o High temperatures can impact the operation and efficiency of certain types of equipment. • Increasing intense precipitation events o Heavy rainfall can result in flash pluvial flooding, which could significantly impact industrial assets. o Drought may alter or reduce availability of water with temperature increase. • Changes in cloud cover, wind speed or increasing temperature extremes o Poses risks to the availability of reliable energy, both electrical or thermal. • Sea-level rises o Potential for flooding of coastal infrastructure and assets at risk from storm surge events. • Increased soil erosion o Risks to the availability of raw materials. o Risk to transport routes for supply chains. Guidance for carrying out Risk Assessments: • Users should apply climate scenarios based on representative concentration pathway (RCP) 4.5 and 8.5 or similar/ equivalent to ensure consideration for worst case scenario.		

[73] High Conservation Value (HCV) habitat criteria in accordance with www.hcvnetwork.org

[74] According to IFC Performance Standards

No.	Adaptation and resilience checklist for hydrogen delivery projects, including conditioning, transportation and storage.	Proof Given	Overall Assessment
		For verifier to complete	
	• Risk assessments should use both top-down methods and bottom-up methods that look at inherent system vulnerabilities in local context. • A broad range of models can be used to generate climate scenarios. • For risk assessment, the TCFD The Use of Scenario Analysis in disclosure of Climate-Related Risks and Opportunities is recommended.		
3.	**Section 3:** The measure is suitable to climate change conditions over its operational life		
3.1	The equipment must be tolerant to the range of climate hazards identified in item 2 of this checklist and not lock-in conditions that could result in maladaptation.		
3.2.	Risk reduction actions/strategies must be tolerant to a range of climate hazards and not lock-in conditions that could result in maladaptation.		
4.	**Section 4:** The measure does no harm to the climate resilience of the defined system it operates within, as indicated by the boundaries of and critical interdependencies with that system as identified in item 1 in this checklist.		
4.1	The equipment itself does not pose significant risk of harm to the system it is located within or others' natural, social, or financial assets according to the principle of best available evidence during the investment period, taking into account the boundaries and critical interdependencies as defined in item 1 in this checklist. Harm is defined as an adverse effect on any of the following items: 1. Adverse effects on local water bodies and water courses; 2. Air pollution from dust and other pollutants; 3. Relationships of the measure to nearby flood zones; 4. Reduction in biodiversity or High Conservation Value75 habitat; 5. Appropriation of land or economic assets from nearby vulnerable groups76.		

[75] High Conservation Value (HCV) habitat criteria in accordance with HCV Network

[76] According to IFC Performance Standards

5 Criteria for entities and Sustainability Linked Debt (SLD)

The following sections detail similar, yet distinct, criteria depending on what is being certified:

- A whole entity (in this case, a business segment or part of a company producing, transporting, or storing hydrogen)- ***Section 5.1***
- SLD issued by an entity dedicated to the production, transportation, or storage of hydrogen - ***Section 5.2***

5.1 Sector specific criteria for eligible non-financial corporates

Entities producing hydrogen:

Two tiers of certification are available for entities producing hydrogen, described in ***Table 11.***

Table 11: Entities Tiered Certifications

Entity Tier	Certification Requirements for Entities Producing Hydrogen
Tier 1 (Aligned)	**Hydrogen Production Climate Mitigation Criteria** 1. At the time of certification, the Certified Entity's hydrogen production facilities average emissions intensity meets the entity level pathway threshold and their future Performance Targets for those facilities continue to align with those declining thresholds through to 2050 (see ***Section 3.2.1.1,*** **Table 4**[77]); *and* 2. The Assessed Entity's Transition Plan provides credible evidence that those future Performance Targets to 2050 will be met (see the Climate Bonds Standard v4.0 (***Part C Section 3 and 4***) for detailed requirements in respect of the Transition Plan and other commitments); *and* 3. The Assessed Entity provides sufficient external transparency and assurance in respect of these Performance Targets and Transition Plans (see the Climate Bonds Standard v4.0 (***Part C Section 5***) for detailed requirements in respect of disclosure and external assurance); *and* 4. If any of the Assessed Entities current of future hydrogen production facilities use alternative feedstocks or alternative fuels, implement electrification or use CCU or CCS, they must meet the respective cross-cutting criteria in ***Section 3.1, Table 2*** **Hydrogen Production Adaptation and Resilience Criteria:** At the time of certification, all the Assessed Entity's facilities meet the adaptation and resilience criteria described in ***Section 3.2.2*** and that is reassessed and reconfirmed every five years during the term of the bond.
Tier 2 (Transition)	**Hydrogen Production Climate Mitigation Criteria** The criteria are the same as for Tier 1, except in respect of point 1: The Assessed Entity's hydrogen production facilities average emissions intensity does not meet the emissions intensity threshold at the time of certification, but the future Performance Targets align with those entity-level emissions thresholds by **2030** and continue to align thereafter through to 2050 (see ***Section 3.2.1.1,*** **Table 4**)

[77] For entity certification, the declining thresholds requirement is regardless of the hydrogen production technology used.

Entities delivering hydrogen:

Two tiers of certification are available for entities dedicated to hydrogen conditioning, transporting, and storing operations, described in ***Table 12***

Table 12: Entities Tiered Certifications

Entity Tier	Certification Requirements for Entities Delivering Hydrogen
Tier 1 (Aligned)	**Hydrogen Delivery (transportation and storage) Climate Mitigation Criteria** • At the time of certification, the hydrogen delivery Assessed Entity demonstrates that the average emissions intensity of the hydrogen they condition, transport or store meets the 3.0 $kgCO_2e/kgH_2$ benchmark in ***section 3.2.1.1;*** and • The Assessed Entity provides credible evidence that demonstrate that their future operations will be focused only on delivering low-carbon hydrogen that meets the 3.0 $kgCO_2e/kgH_2$ benchmark in ***section 3.2.1.1***; *and* • The Assessed Entity provides sufficient external transparency and assurance in respect of these Performance Targets and Transition Plans (see the draft Climate Bonds Standard v4.0 (***Part C Section 5***) for detailed requirements in respect of disclosure and external assurance); *and* • The Assessed Entities meet the respective criteria in ***Section 4*** **Hydrogen Delivery Adaptation and Resilience Criteria:** At the time of certification, all of the Assessed Entity's segments or business units meet the adaptation and resilience criteria described in ***section 4.2*** and that is reassessed and reconfirmed every five years during the term of the bond.
Tier 2 (Transition)	**Hydrogen Delivery** The criteria are the same as for Tier 1, except in respect of point 1: The Assessed Entity cannot demonstrate that the average emissions intensity of the hydrogen to be transported or stored meets the pathway threshold[78] at the time of certification, but their future Performance Targets align with those entity-level emissions thresholds by 2030 and continue to align thereafter through to 2050 (see ***Section 3.2.1.1,*** Table 4).

5.2 Criteria for Sustainability Linked Debt (SLDs)

SLDs cover Sustainability Linked Bonds (SLBs) and Sustainability Linked Loans (SLLs).

Hydrogen production projects:

Two tiers of SLD certification are available for hydrogen production projects, described in ***Table 13***:

Table 13: SLD Tiered Certifications

SLD Tier	Certification Requirements for SLDs related to Hydrogen Production Projects
Tier 1 (Aligned)	**Hydrogen Production Climate Mitigation Criteria** 1. At the time of certification, the average emissions intensity of the hydrogen production facilities to which the future Performance Targets of the debt are linked and their future Performance Targets for those facilities continue to align with those declining thresholds through to 2050 (see ***Section 3.2.1.1, Table 4***); *and* 2. The Assessed Entity's Transition Plan provides credible evidence that those future Performance Targets to 2050 will be met (see the draft Climate Bonds Standard v4.0 (***Part D Section 3 and 4***) for detailed requirements in respect of the Transition Plan other commitments); *and*

[78] It is necessary to present a commercial agreement or purchasing policy that includes low-carbon hydrogen emissions intensity as a requirement.

	3. The Assessed Entity provides sufficient external transparency and assurance in respect of these Performance Targets and Transition Plans (see the draft Climate Bonds Standard v4.0 (***Part D Sections 5***) for detailed requirements in respect of disclosure and external assurance); *and* 5. If any of the Assessed Entities current of future hydrogen production facilities use alternative feedstocks or alternative fuels, implement electrification or use CCU or CCS, they must meet the respective cross-cutting criteria in ***Section 3.1, Table 2.*** 6. For any plant becoming operational post certification date, that plant will meet the criteria described in ***Section 3.2.1*** from day 1 of commencing operation. Details of this to be provided in the company's transition plan. **Hydrogen Production Adaptation and Resilience Criteria:** At the time of certification, all of the assessed entity's facilities meet the adaptation and resilience criteria described in ***Section 3.2.2*** and that is reassessed and reconfirmed every five years during the term of the bond.
Tier 2 (Transition)	**Hydrogen Production** The criteria are the same as for Tier 1, except: The Assessed Entity hydrogen production facilities average emissions intensity does not meet the emissions intensity threshold at the time of certification, but the future Performance Targets align with those entity-level emissions thresholds by **2030** and continue to align thereafter through to 2050 (see ***Section 3.2.1.1, Table 4)***

Hydrogen delivery projects:

Two tiers of SLD certification are available for hydrogen delivery projects, described in ***Table 13***:

SLD Tier	Certification Requirements for SLDs related to Hydrogen Delivery Projects
Tier 1 (Aligned)	**Hydrogen Delivery (transportation and storage) Climate Mitigation Criteria** • At the time of certification, the hydrogen delivery Assessed Entity demonstrates that the average emissions intensity of the hydrogen they condition, transport or store meets the 3.0 $kgCO_2e/kgH_2$ benchmark in ***section 3.2.1.1;*** and • The Assessed Entity provides credible evidence that demonstrate that their future operations will be focused only on delivering low-carbon hydrogen that meets the 3.0 $kgCO_2e/kgH_2$ benchmark in ***section 3.2.1.1***; *and* • The Assessed Entity provides sufficient external transparency and assurance in respect of these Performance Targets and Transition Plans (see the draft Climate Bonds Standard v4.0 (***Part C Section 5***) for detailed requirements in respect of disclosure and external assurance); *and* • The Assessed Entities meet the respective criteria in ***Section 4*** **Hydrogen Delivery Adaptation and Resilience Criteria:** At the time of certification, all the assessed entity's segments or business units meet the adaptation and resilience criteria described in ***section 4.2*** and that is reassessed and reconfirmed every five years during the term of the bond.
Tier 2 (Transition)	**Hydrogen Delivery** The criteria are the same as for Tier 1, except in respect of point 1: The Assessed Entity cannot demonstrate that the average emissions intensity of the hydrogen to be transported or stored meets the threshold[79] at the time of certification, but the future Performance Targets of the hydrogen supplier align with those entity-level emissions thresholds by 2030 and continue to align thereafter through to 2050 (see ***Section 3.2.1.1, Table 4***).

Appendix A: TWG and IWG members

[79] It is necessary to present a commercial agreement or purchasing policy that includes low-carbon hydrogen emissions intensity as a requirement.

Climate Bonds Coordinator			
Marian Rodriguez Senior Research Analyst	Climate Bonds Initiative		
External Technical Lead Advisor:			
Emre Gençer Principal Research Scientist	MIT Energy Initiative		
TWG Members			
Clarissa Bergman Fonte Researcher in Energy planning	Federal University of Rio de Janeiro, Brazil	**Álvaro Bobadilla** Energy Analyst	HINICIO (Chile)
Cédric Philibert Senior Energy Consultant.	Independent	**Maria de los Angeles Valenzuela** Manager Consultant	HINICIO (Chile)
Gabriela Nascimento da Silva Hydrogen consultant	KfW (the development bank of Germany)	**Marta Lovisolo** Advisor on Renewable Energy Systems	Bellona Europa
Giuseppe Bianchi Senior Professional in Innovation and Decarbonisation	Independent. Former IEA analyst	**Patrick Molloy** Manager Breakthrough Technologie	Rocky Mountain Institute (RMI)
Gniewomir Flis Associate, Senior Advisor Hydrogen	Energy Revolution Ventures	**Rachel Fakhry** Green Hydrogen Sector Lead	Climate Champions. Race to zero UNFCCC
Joe Powell Director Energy Transition Institute	University of Houston	**Zainab Datti** Technical Advisor	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
Zaffar Hussain Project Lead PtX Africa	Agora Energiewende		
Additional experts consulted:			
Herib Blanco Analyst - Hydrogen Energy (Power to X)	International Renewable Energy Agency (IRENA)		
Sarah Torkamani Environmental and energy policy expert	Independent		
Graeme Sweeney Chair of the Advisory Council	European Technology Platform of Zero Emission		

IWG Members	
CWP Global	Institutional Investors Group on Climate Change (IIGCC)
Bureau Veritas	JCRA (Japan Credit Rating Agency)
Carbon Trust	Kawasaki Heavy Industries
China Hydrogen Alliance	Mizuho International
Eletrobras	NSW | Point Advisory an ERM Group Company
Hydrogen Brazil	Rubicola Consulting
Hydrogen Europe	Snam
IFA (International Fertilisers Association)	Socalgas
IHI Corporation	Sustainalytics